# The Klang River environmental problems : an overview

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By

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Paper No.11

River + environment Malaysia

# THE KLANG RIVER ENVIRONMENTAL PROBLEMS

# : AN OVERVIEW

by

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DEPARTMENT of ENVIRONMENT

MALAYSIA

25 September 1987

## GLOSSARY

**Ammóniacal Nitrogen (AN)** - an indicator of organic pollution from human and animal wastes.

**Biochemical Oxygen Demand (BOD)** - dissolved oxygen needed by microorganisms to break down organic waste matter in water.

**Biodegradable** - capable of being broken down by bacteria into basic elements and compounds. Most organic waste and paper is biodegradable

**Degradable pollutant** - water or soil pollutant (such as organic wastes) that can be naturally broken by natural microorganisms

**Detergent** - synthetic, organic, liquid, or water soluble cleansing agent that has wetting-agent and emulsifying-agent properties. Unlike soap, detergents are not manufactured from fats and oils.

**Dissolved Oxygen (DO)** - extent to which oxygen occurs dissolved in water or wastewater. It is usually expressed as concentration,in parts per million, or percent of saturation.

**Ecology** - study of relationships of living organisms with each other and with their environment, study of structure and function of nature.

**Effluent** - any solid, liquid or gas that enters the environment from a point source but usually restricted to liquid. Generally refers to wastewater from the sewage treatment or industrial plant.

**Environment** - aggregate of external conditions that influence the life of individual organism or population.

**Eutrophication** - condition of high nutrient enrichment in an equatic ecosystem, supporting a larger amount of equatic life, which depletes the oxygen supply.

**Hardness** - condition of water, caused by dissolved calcium, magnesium and irons such as bicarbonates, carbonates, sulphate, chloride and nitrates.

**Heavy Metals** - group of metallic elements with relatively high atomic weights. They include mercury, iron, cobalt, cadmium, lead, nickel and a number of others.

**Lagoon** - in sewage treatment, pond in which sunlight, algae and oxygen interact to restore water to a quality equal to effluent from a secondary treatment plant.

**Methylene Blue Active Subtances (MBAS)** - invariably refers to synthetic detergents

**Nitrate (NO3-)** - negatively charged chemical group consisting of one and three oxygen atoms. A major component of some chemical fertilizers.

**pH** - numeric value that indicates the relative acidity or alkalinity of a substance on a 0 to 14 scale with neutral point at 7.0. Values lower than 7.0 indicate the presence of acids and greater than 7.0 the presence of alkalis

**Primary treatment of sewage** - treatment in which large solids like old shoes and plastics are screened out and sewage is allowed to settle in a large tank for a few minutes.

**Runoff** - lateral movement of nutrients and soil to surface waters.

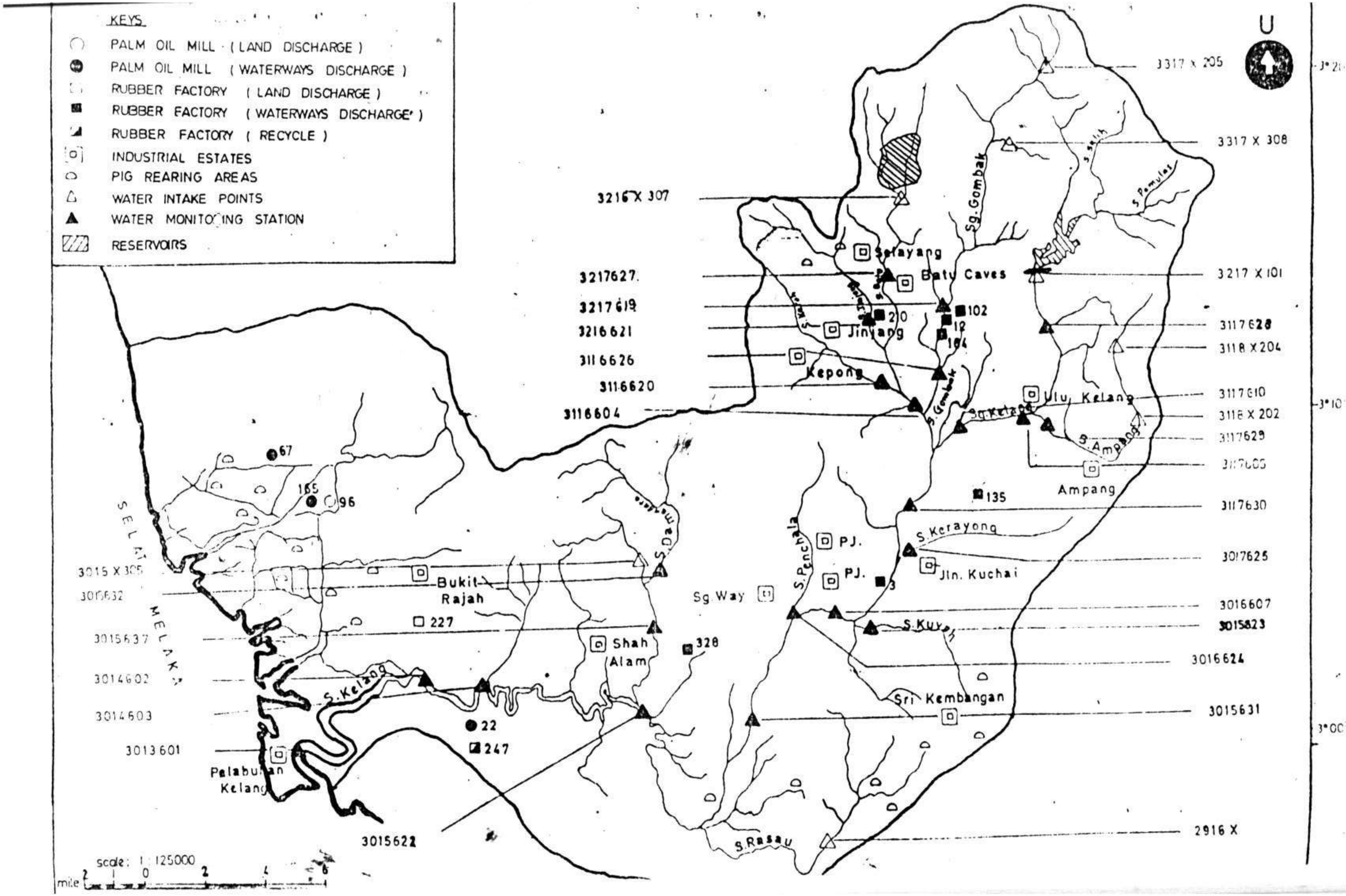
**Sanitary Landfill** - dumping process whereby garbage or other refuse is covered with soil, thus controlling smells, rodent activity etc. and speeding the decay of organic subtances.

**Secondary Treatment** - secondary step in most waste treatment systems in which bacteria consume the organic parts of the wastes.

**Septic Tank** - underground tank that receives waste water directly from the house. The bacteria in the sewage decompose the organic wastes and the sludge settles to the bottom of the tank. The effluent flows out of the tank into drains or percolation field.

**Turbidity** - in water quality, the expression of the optical property that causes light to be scattered and absorbed (expressed in turbidity units).The turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter and microscopic organisms.

**Watershed** - land area from which water drains toward a common water course in a natural basin.


KEYS
PALM OIL MILL (LAND DISCHARGE)
PALM OIL MILL (WATERWAYS DISCHARGE)
RUBBER FACTORY (LAND DISCHARGE)
RUBBER FACTORY (WATERWAYS DISCHARGE)
RUBBER FACTORY (RECYCLE)
INDUSTRIAL ESTATES
PIG REARING AREAS
WATER INTAKE POINTS
WATER MONITORING STATION
RESERVOIRS
U
Sg. Gombak
S. Pamulas
Selayang
Batu Caves
Jinjang
Kepong
S. Gombak
Ulu Kelang
Sg. Kelang
S. Ampang
Ampang
S. Kerayong
PJ.
Jln. Kuchai
S. Penchala
Sg. Way
S. Kuyoh
Sri Kembangan
S. Rasau
S. Damansara
Bukit Rajah
Shah Alam
S. Kelang
Pelabuhan Kelang
SELAT MELAKA
102
12
104
20
135
3
328
227
22
247
67
165
96
3216 X 307
3217627
3217619
3216621
3116626
3116620
3116604
3317 X 205
3317 X 308
3217 X 101
3117628
3118 X 204
3117610
3118 X 202
3117629
3117630
3017625
3016607
3015823
3016624
3015631
2916 X
3015622
3015 X 305
3015632
3015637
3014602
3014603
3013601
3°20
3°10
3°00
scale: 1 : 125000
mile 2 1 0 2 4 6

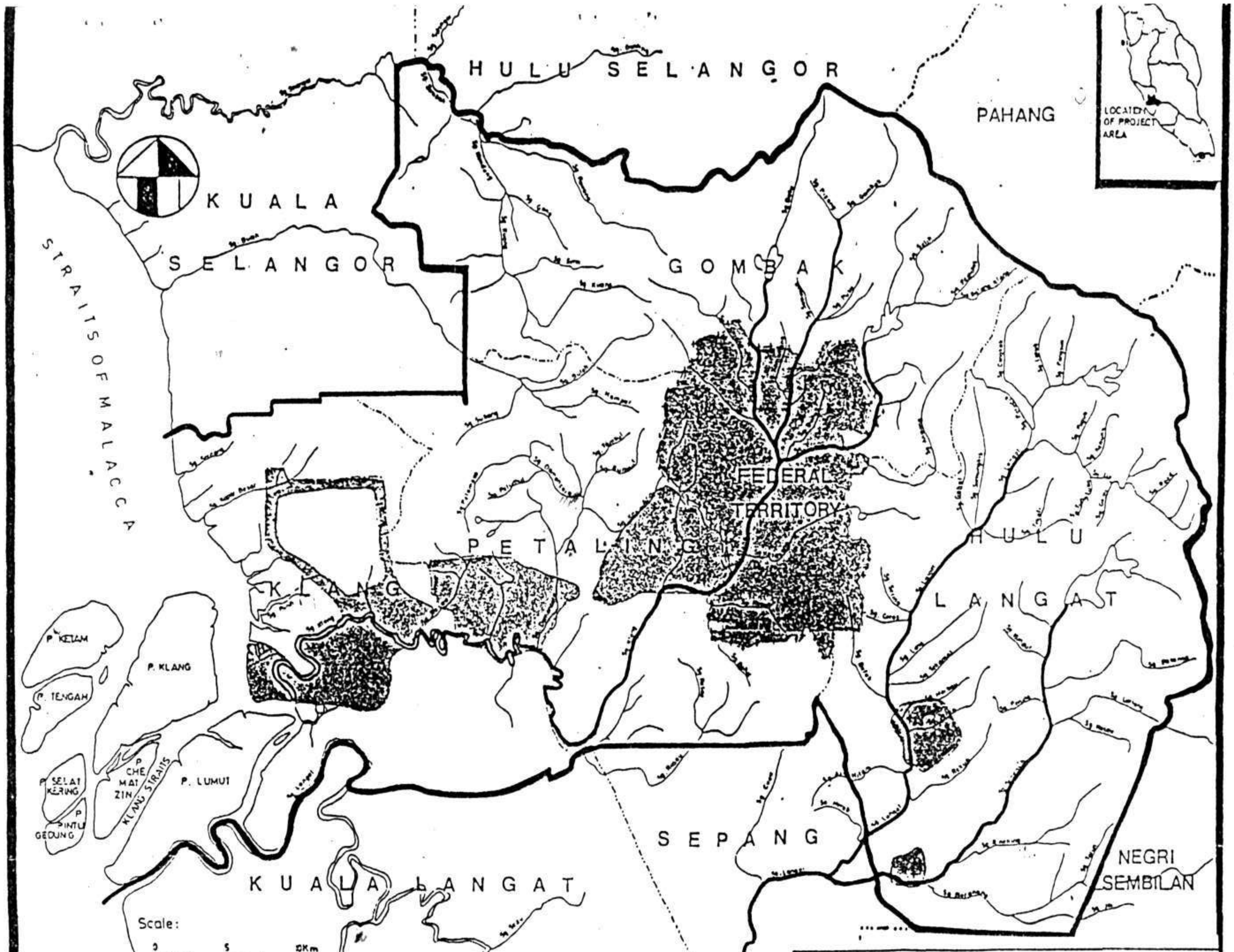
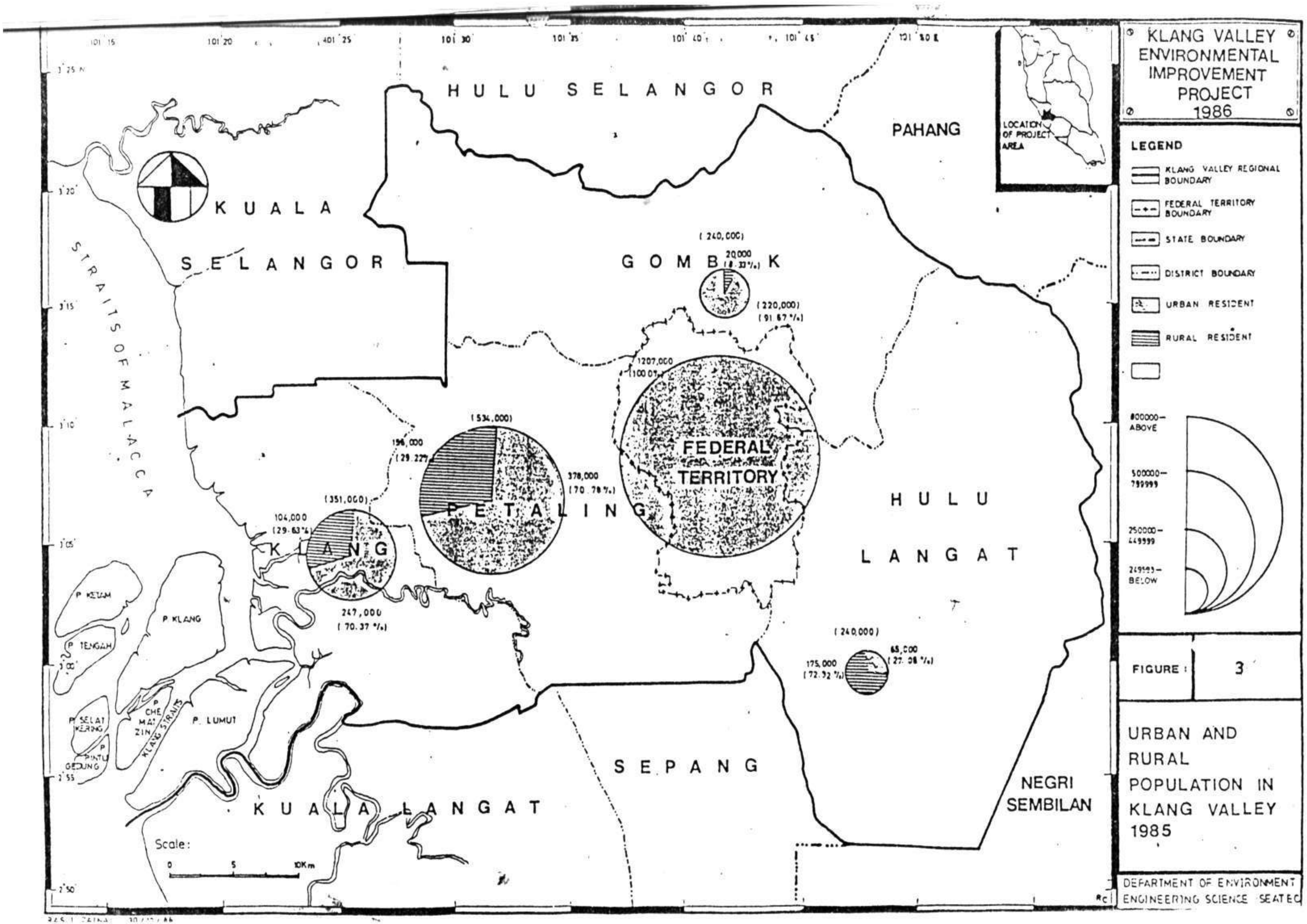
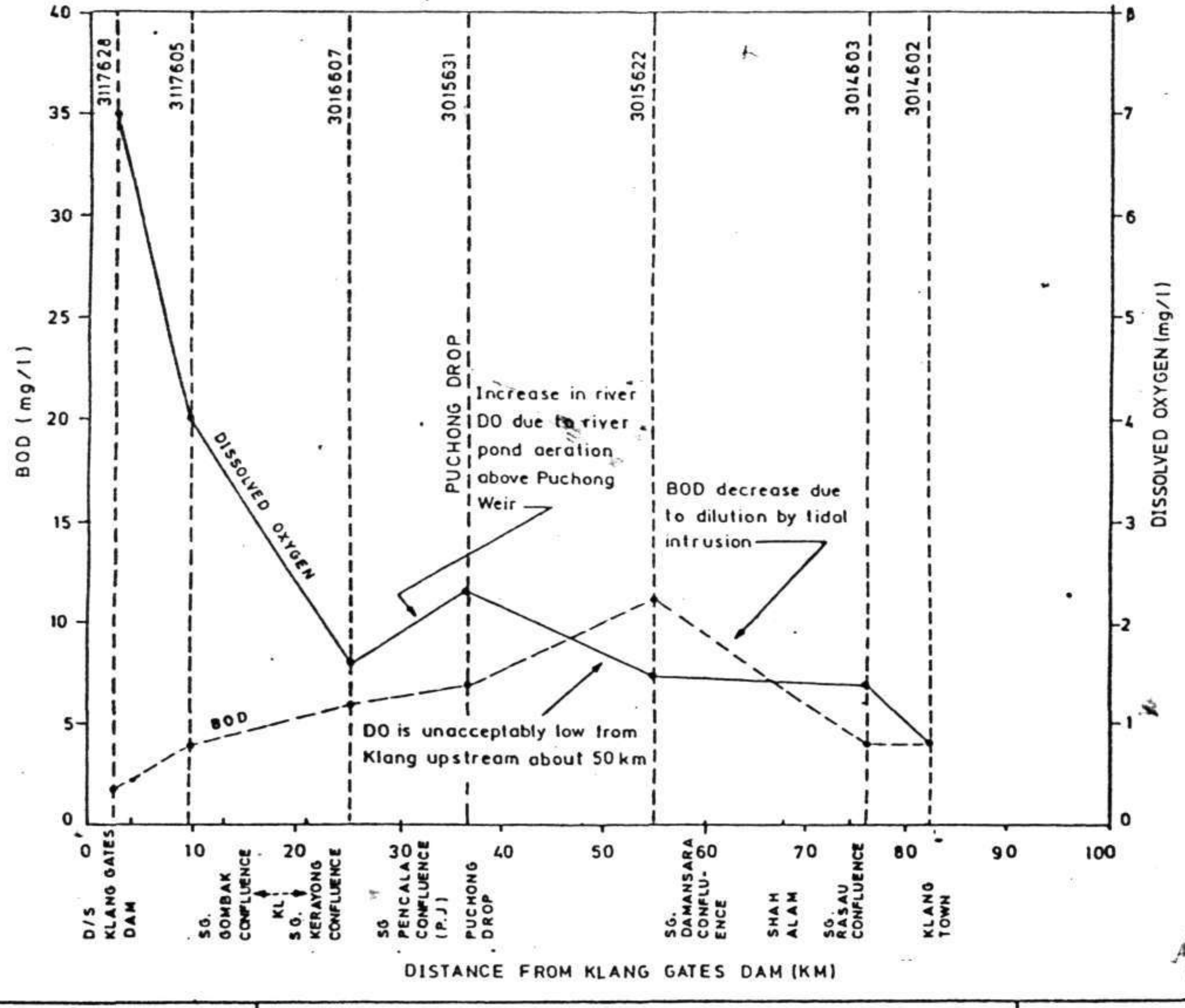
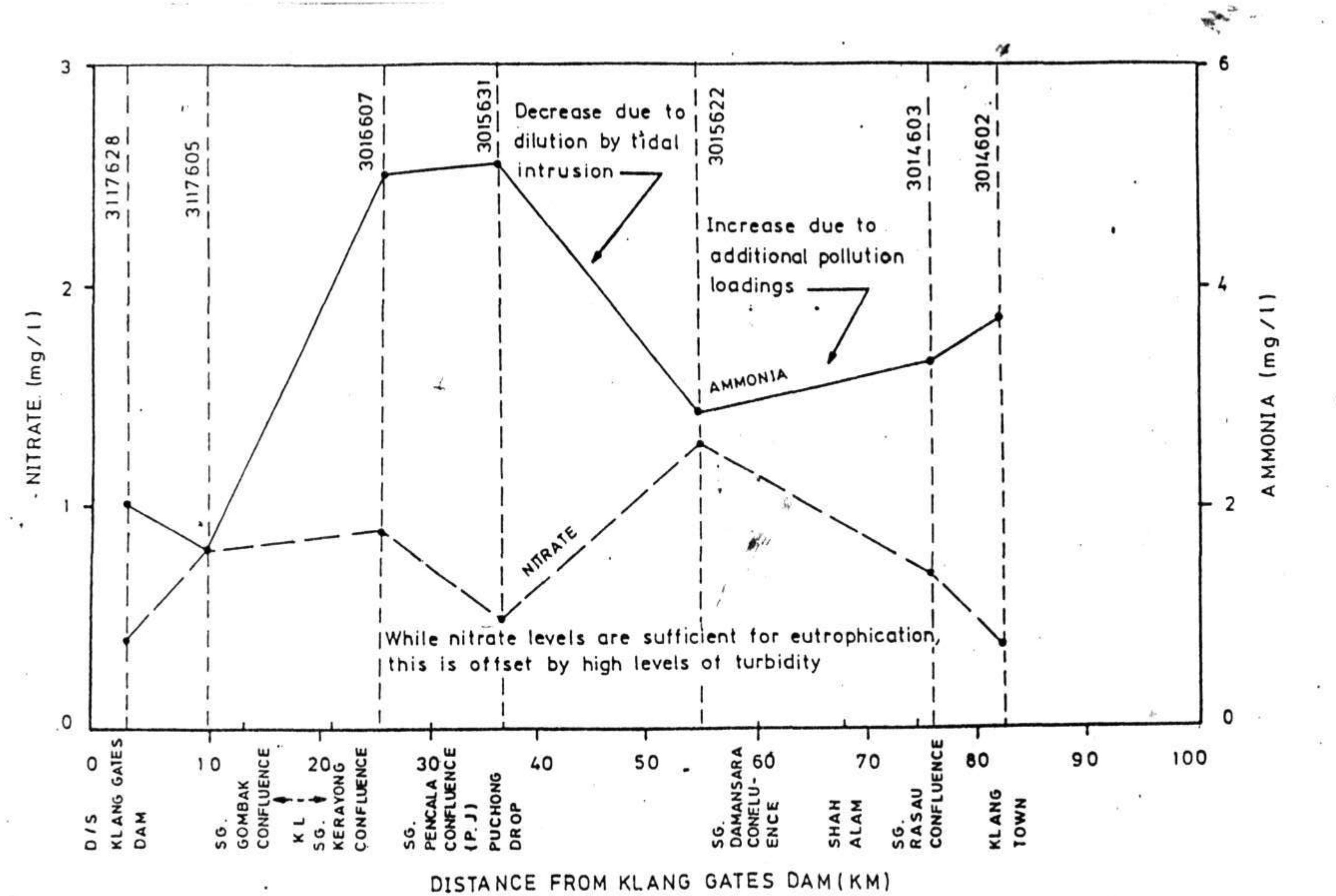



FIGURE 2 : KLANG VALLEY : BUILT UP AREAS

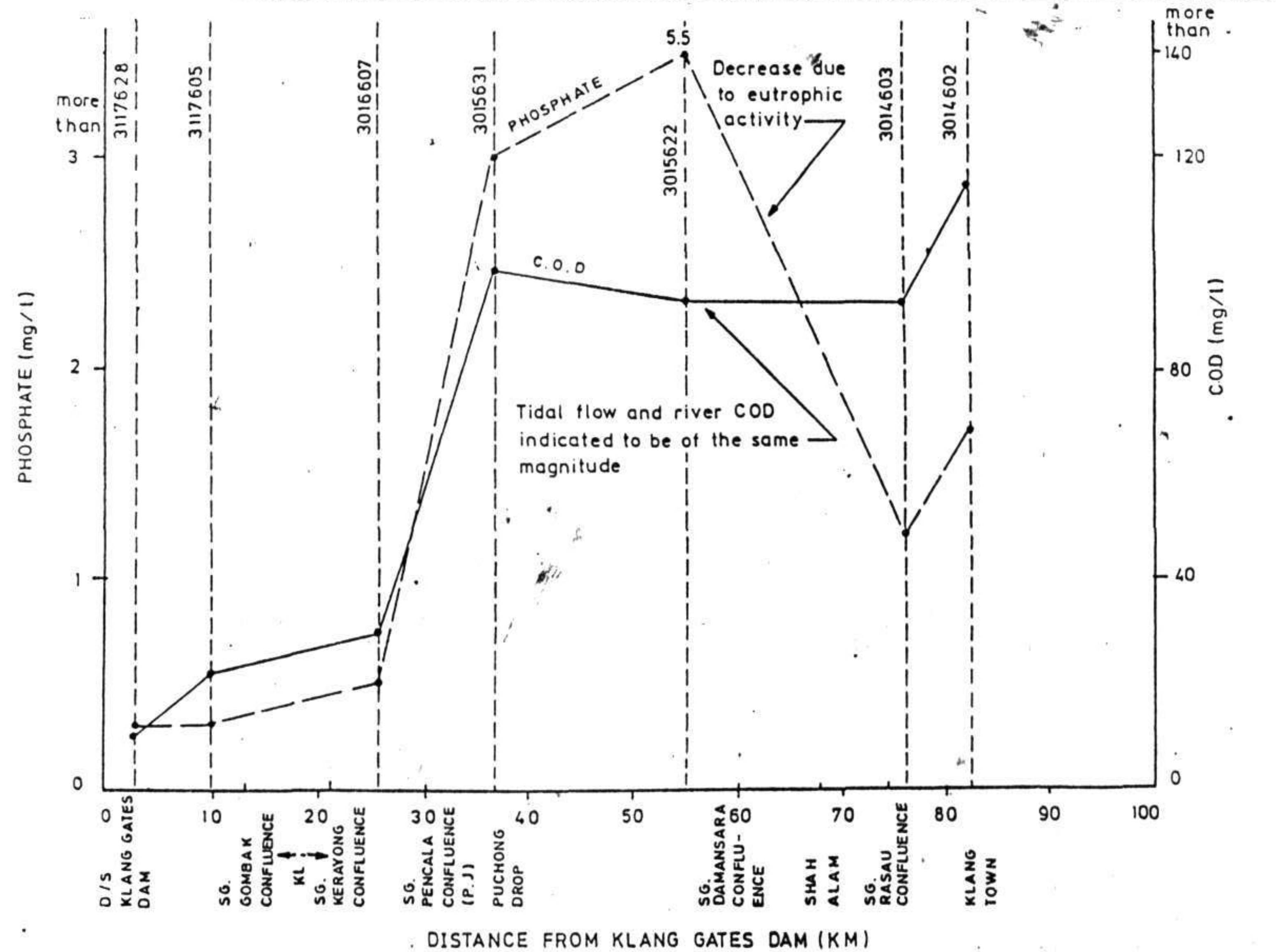

KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT 1986
LEGEND
KLANG VALLEY REGIONAL BOUNDARY
FEDERAL TERRITORY BOUNDARY
STATE BOUNDARY
DISTRICT BOUNDARY
URBAN RESIDENT
RURAL RESIDENT
800000–ABOVE
500000–799999
250000–449999
249999–BELOW
FIGURE : 3
URBAN AND RURAL POPULATION IN KLANG VALLEY 1985
DEPARTMENT OF ENVIRONMENT ENGINEERING SCIENCE SEATEC
LOCATION OF PROJECT AREA
HULU SELANGOR
PAHANG
KUALA SELANGOR
GOMBAK
(240,000)
20,000 (8.33%)
(220,000) (91.67%)
1207,000 (100%)
FEDERAL TERRITORY
(534,000)
156,000 (29.22%)
378,000 (70.78%)
PETALING
(351,000)
104,000 (29.63%)
247,000 (70.37%)
KLANG
HULU LANGAT
(240,000)
65,000 (27.08%)
175,000 (72.92%)
SEPANG
NEGRI SEMBILAN
KUALA LANGAT
STRAITS OF MALACCA
P. KETAM
P. KLANG
P. TENGAH
P. SELAT KERING
P. CHE MAT ZIN
KLANG STRAITS
P. LUMUT
P. PINTU GEDUNG
Scale: 0 5 10Km



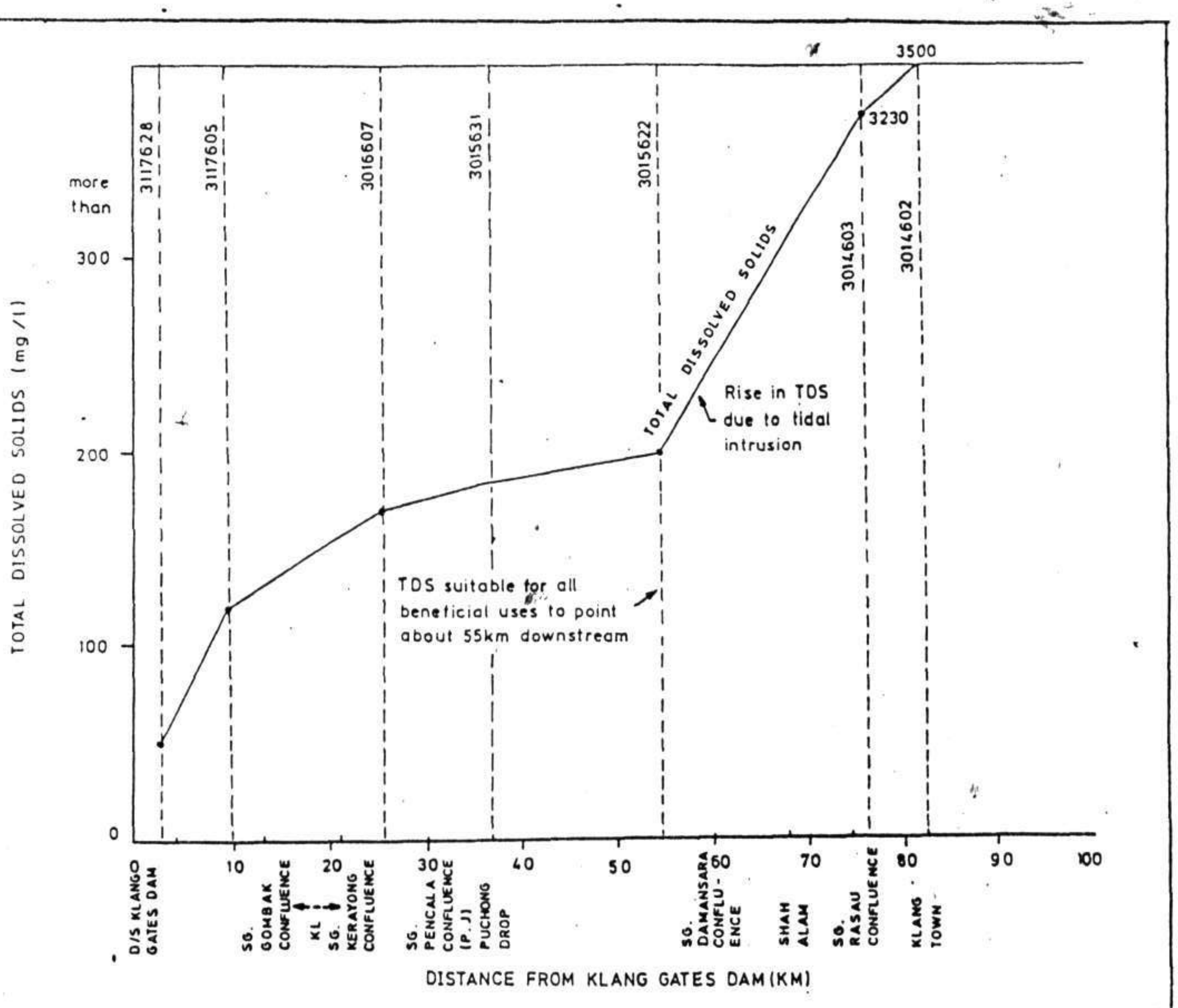

| | | |
|---|---|---|
| KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT | BOD AND DO VARIATION ALONG KLANG RIVER FOR LOW FLOW CONDITIONS, 1981-1984 | FIGURE : 4 |



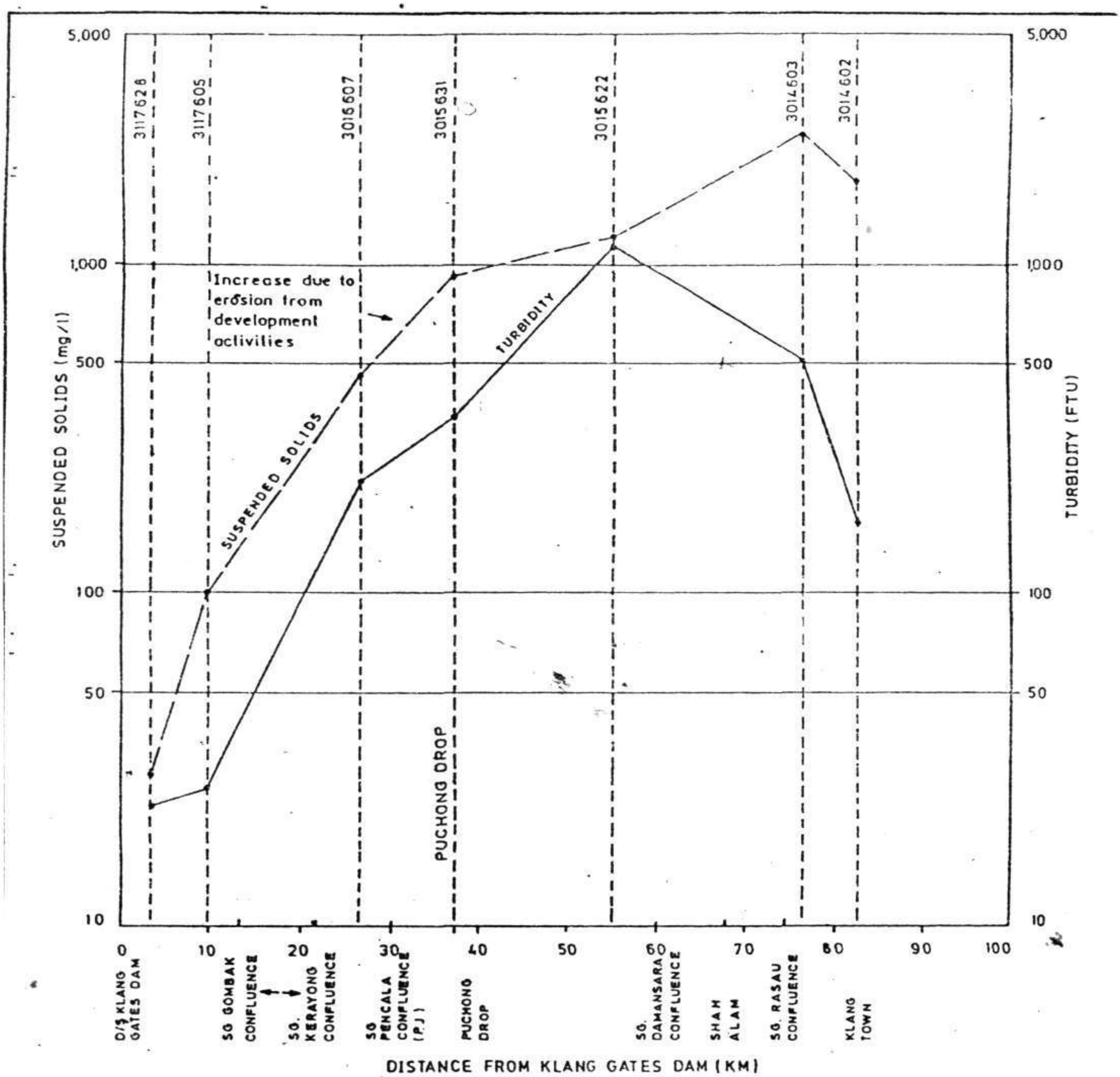

| KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT | AMMONIA AND NITRATE VARIATION ALONG KLANG RIVER FOR LOW FLOW CONDITIONS, 1981 - 1984 | FIGURE : 5 |
|---|---|---|



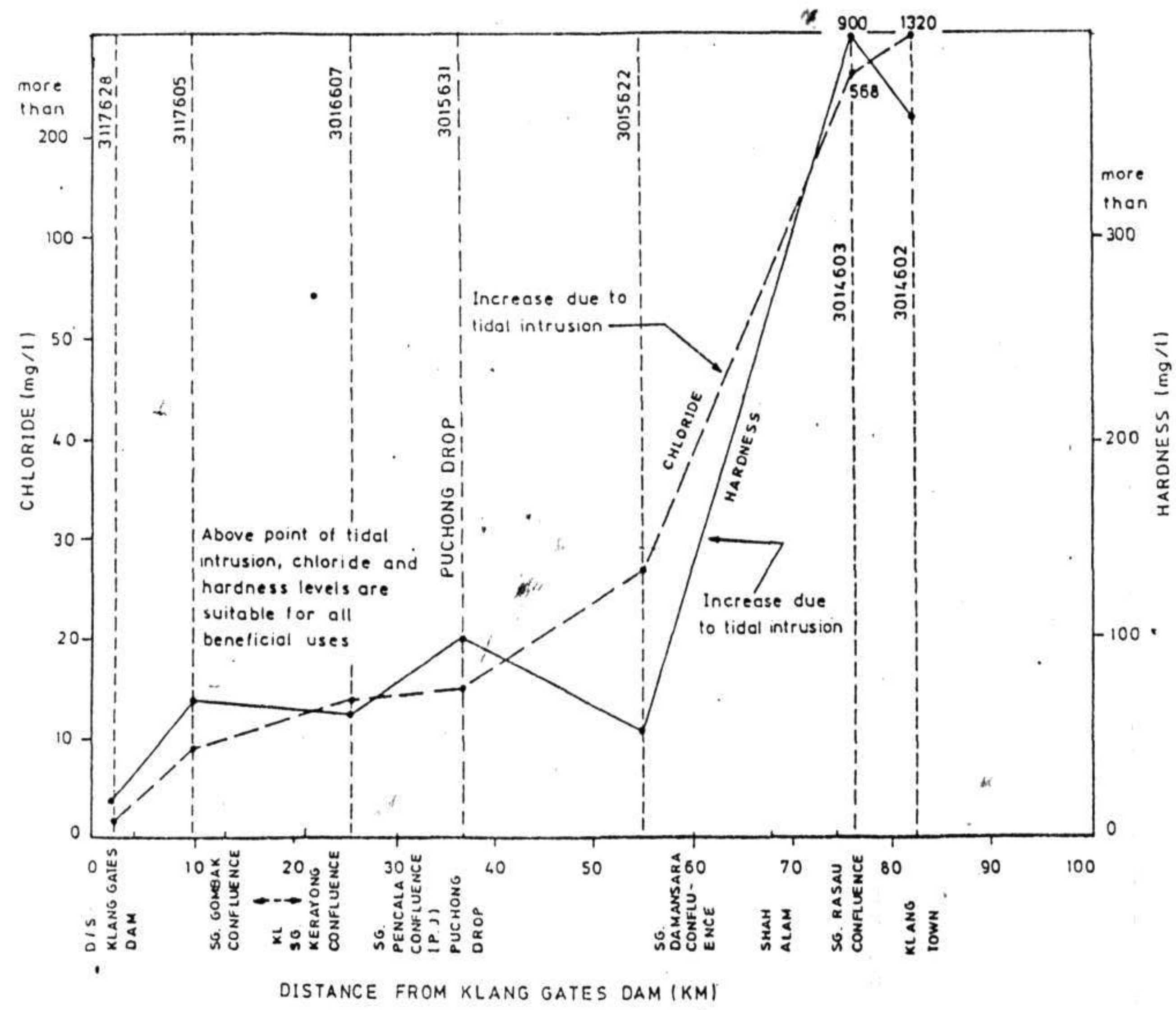

| KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT | COD AND PHOSPHATE VARIATION ALONG KLANG RIVER FOR LOW FLOW CONDITIONS, 1981 - 1984. | FIGURE : 6 |
|---|---|---|




| KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT | TOTAL DISSOLVED SOLIDS VARIATION ALONG KLANG RIVER FOR LOW FLOW CONDITIONS, 1981 - 1984 | FIGURE [illegible] |
| --- | --- | --- |



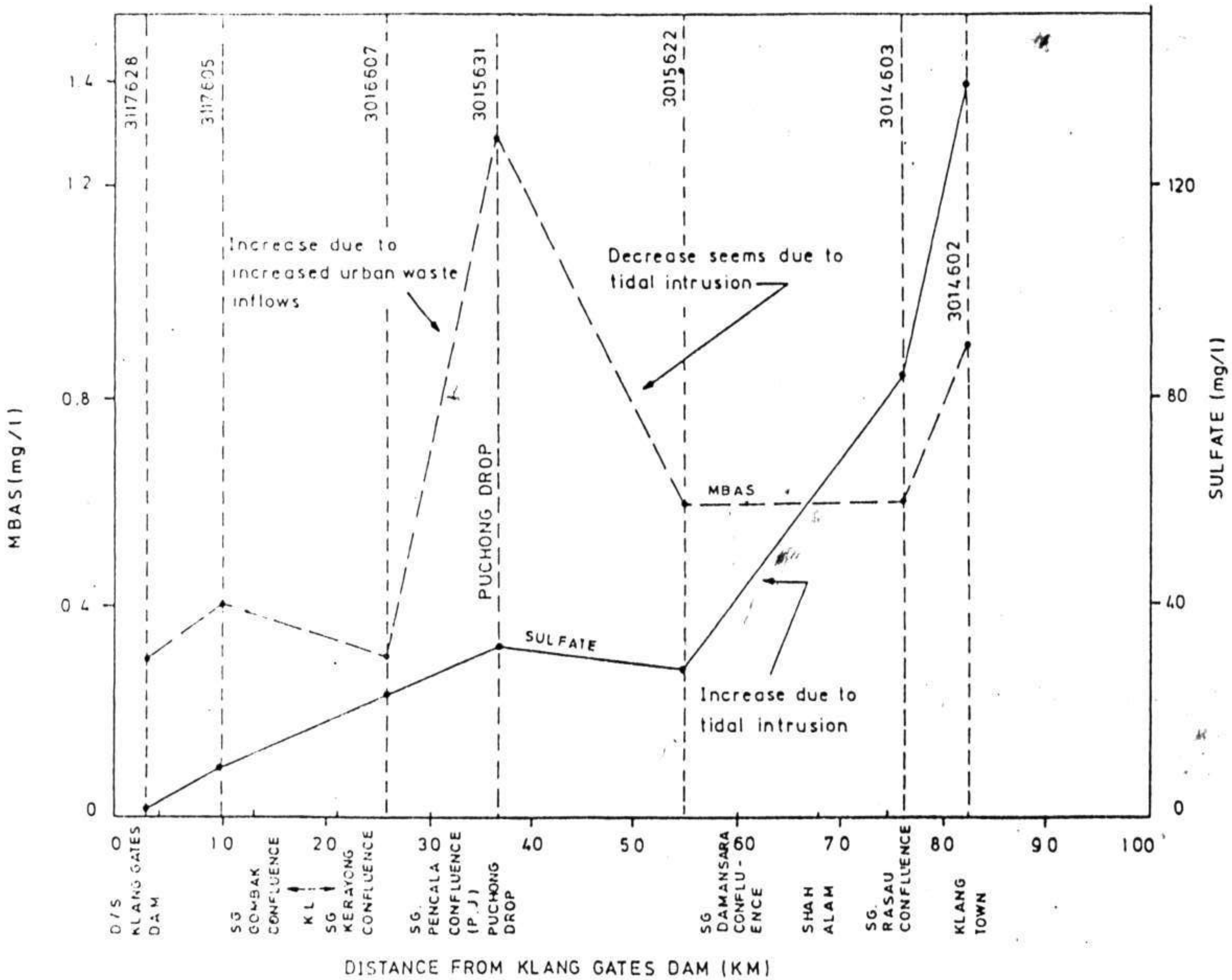

| | | |
|---|---|---|
| KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT | SUSPENDED SOLIDS AND TURBIDITY VARIATION ALONG KLANG RIVER FOR LOW FLOW CONDITIONS, 1981 - 1984. | FIGURE : 8 |



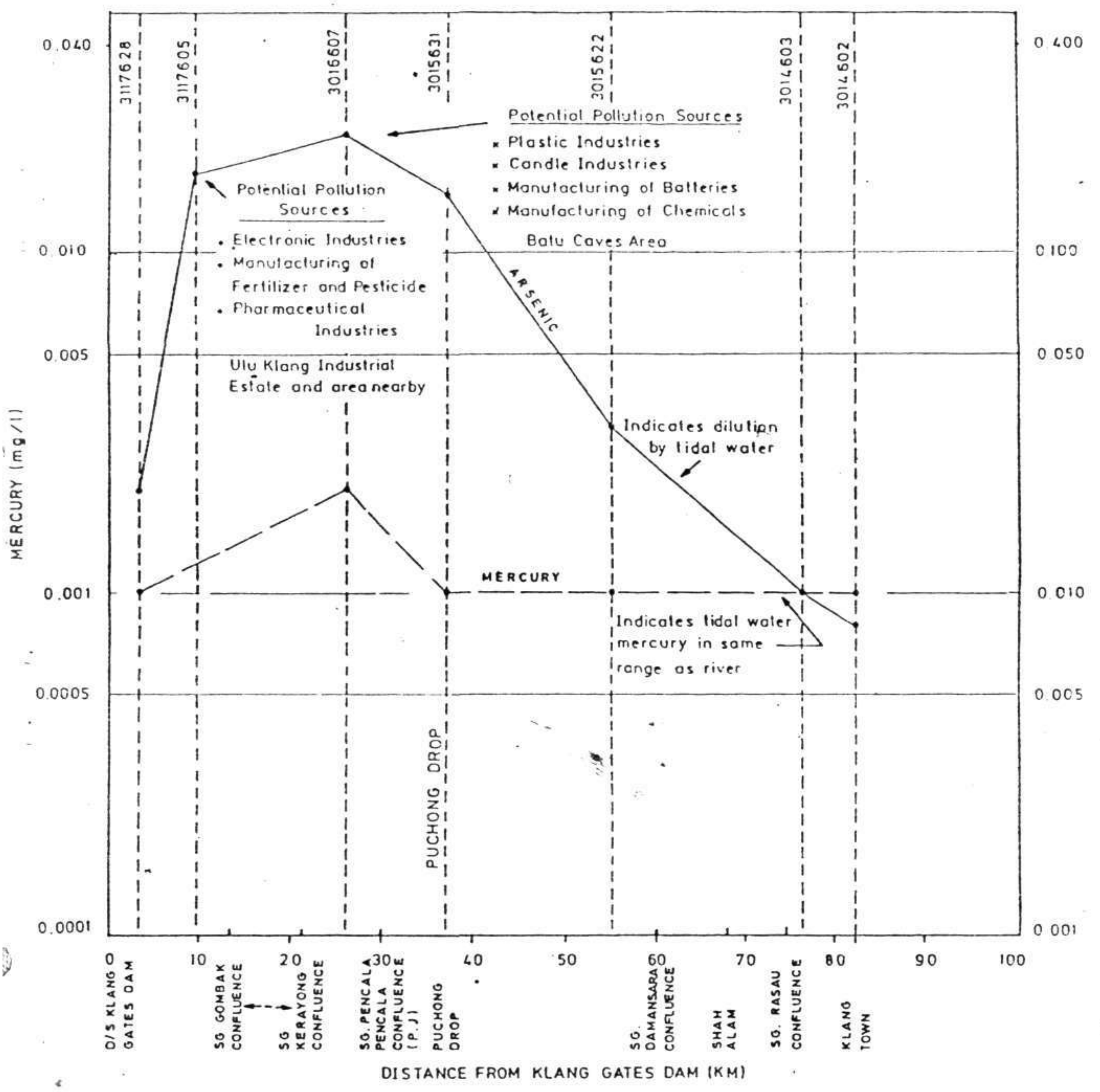

KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT

CHLORIDE AND HARDNESS VARIATION ALONG KLANG RIVER FOR LOW FLOW CONDITIONS, 1981 - 1984

FIGURE : 9




| | | |
|---|---|---|
| KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT | MBAS AND SULFATE VARIATION ALONG KLANG RIVER FOR LOW FLOW CONDITIONS, 1981 - 1984 | FIGURE : 10 |




| KLANG VALLEY ENVIRONMENTAL IMPROVEMENT PROJECT | ARSENIC AND MERCURY VARIATION ALONG KLANG RIVER FOR LOW FLOW CONDITIONS, 1981 - 1984 | FIGURE: 11 |
|---|---|---|

TABLE : 1

SOLID WASTE BOD LOADS FOR KLANG VALLEY, 1985

| District | Population | BOD, Kg/day |
|---|---|---|
| Federal Territory | 1,207,000 | 1,175 |
| Petaling | 454,000 | 442 |
| Klang | 324,000 | 315 |
| Gombak | 240,000 | 234 |
| Ulu Langat | 240,000 | 234 |
| Klang Valley | 2,465,000 | 2,400 |

Note: Assumed 1 ton of putrescibles generates @ 80 kg of BOD. Therefore 30 tons of putrescibles generates 2,400 kg of BOD.

TABLE: 2

MAJOR POLLUTING INDUSTRIES IN KLANG VALLEY

| CATEGORY | Industry REF NO | FLOW (cu m/day | LOAD (Kg/Day) BOD | SS | AN |
|---|---|---|---|---|---|
| Breweries. | 2 | 2315 | 6250 | 4630 | 14 |
| | 6 | 70 | 57 | 6 | - |
| | 3 | 32 | 3 | 35 | - |
| Soft Drink Industries | 1 | 21 | 21 | 36 | - |
| | 8 | 341 | 708 | 271 | - |
| | 25 | 437 | 256 | 15 | - |
| Food Processing Industries | 7 | 480 | 384 | - | - |
| | 2F | 409 | 491 | 118 | - |
| | 3F | 780 | 281 | 246 | - |
| | 135 | 42 | 42 | 51 | - |
| | 161 | 48 | 71 | 1000 | - |
| Chemical Manufacturing Industries | 1C | 341 | 511 | 682 | - |
| | 8C | 75 | 45 | 22 | - |
| | 16C | 90 | 11 | - | 1 |
| Semi-Conductor and Electrical Industries | 30 | 3000 | 150 | 300 | 200 |
| Rubber Processing Industries | 245 | 136 | 106 | - | - |
| | 259 | 230 | 90 | 54 | 89 |
| | 3 | 99 | 599 | 80 | 62 |
| | 12 | 269 | 26 | 31 | 89 |
| | 102 | 1067 | 28 | 43 | 9 |
| | 135 | 171 | 9 | 19 | 9 |
| | 164 | 2617 | 341 | 532 | 21 |
| | 210 | 1170 | 119 | 234 | 11 |
| | 112 | 1000 | 64 | 60 | 25 |
| | 132 | 132 | 6 | 10 | 0.2 |
| | 330 | 288 | 66 | 29 | 6 |
| Palm Oil Processing Industries | 55 | 264 | 85 | 973 | 83 |
| | 67 | 9 | 0.6 | 4 | 0.01 |
| | 165 | 299 | 40 | 442 | 36 |
| | 168 | 125 | 18 | 18 | 14 |

Source: Department of Environment

TABLE : 3

INDUSTRIAL WASTEWATER LOADS FROM KLANG VALLEY ZONES

| Location | KV Zone | 1985 BOD | 1985 Flow | 1995 BOD | 1995 Flow | 2005 BOD | 2005 Flow |
|---|---|---|---|---|---|---|---|
| Setapak | 47 | 0.3 | 950 | 0.7 | 2,200 | 1.6 | 5,000 |
| Ulu Klang | 10 | 0.70 | 2,300 | 0.7 | 2,300 | 0.7 | 2,300 |
| Batu Caves/ Kepong | 14 | 0.40 | 1,200 | 0.5 | 1,500 | 0.6 | 2,000 |
| Jinjang | 41 | 0.5 | 1,500 | 0.9 | 2,700 | 1.4 | 4,400 |
| Kepong | 45 | 0.95 | 2,800 | 0.95 | 3,000 | 1.0 | 3,000 |
| Gombak | 46 | 0.50 | 1,450 | 0.8 | 2,400 | 0.9 | 2,700 |
| Segambut | 42 | 1.10 | 3,600 | 1.2 | 3,600 | 1.2 | 3,600 |
| K.L. | 40 | 0.30 | 800 | 0.5 | 1,450 | 0.8 | 2,500 |
| Sg. Besi | 35 | 1.20 | 3,800 | 1.2 | 3,800 | 1.2 | 3,800 |
| Cheras | 11 | 0.15 | 500 | 0.2 | 500 | 0.2 | 500 |
| K.L. | 30 | 1.1 | 3,500 | 1.8 | 5,500 | 2.9 | 9,000 |
| K.L. | 32 | 1.40 | 4,300 | 1.4 | 4,300 | 1.4 | 4,300 |
| Petaling Jaya | 27 | 5.9 | 18,400 | 7.0 | 24,000 | 9.0 | 29,000 |
| Batu Tiga/ Puchong | 49 | 3.60 | 11,400 | 4.7 | 14,000 | 5.9 | 18,300 |
| Shah Alam | 24 | 6.10 | 19,000 | 8.0 | 27,000 | 9.0 | 31,000 |
| Bkt Rajah | 19 | 0.20 | 700 | 0.3 | 850 | 0.4 | 1,100 |
| Klang | 21 | 1.50 | 4,800 | 4.4 | 13,600 | 7.9 | 25,000 |
| North Klang | 25 | 2.0 | 5,000 | 3.0 | 8,000 | 4.0 | 9,500 |
| Bangi/ Kajang | 54 | 0.4 | 2,000 | 0.5 | 2,500 | 0.7 | 3,500 |

Units: BOD, tons/day
Flow, cu m/day

TABLE : 4

PROPOSED INTERIM NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

| PARAMETERS | (units) | I | IIA | IIB | III | IV | V |
|---|---|---|---|---|---|---|---|
| | | CLASSES | | | | | |
| Ammoniacal Nitrogen | mg/L | 0.1 | 0.3 | 0.3 | 0.9 | 2.7 | >2.7 |
| BOD | mg/L | 1 | 3 | 3 | 6 | 12 | >12 |
| COD | mg/L | 10 | 25 | 25 | 50 | 100 | >100 |
| DO | mg/L | 7 | 5-7 | 5-7 | 3-5 | <3 | <1 |
| pH | | 6.5-8.5 | 6-9 | 6-9 | 5-9 | 5-9 | - |
| Colour | TCU | 15 | 150 | 150 | - | - | - |
| Elect. Cond.* | μmhos/cm | 1000 | 1000 | - | - | 6000 | - |
| Floatables | | N | N | N | - | - | - |
| Odour | | N | N | N | - | - | - |
| Salinity* | °/oo | 0.5 | 1 | - | - | 2 | - |
| Taste | | N | N | N | - | - | - |
| Total Diss. Solid* | mg/L | 500 | 1000 | - | - | 4000 | - |
| Total Susp. Solids | mg/L | 25 | 50 | 50 | 150 | 300 | >300 |
| Temperature | °C | - | Normal ±2 | - | Normal ±2 | - | - |
| Turbidity | NTU | 5 | 50 | 50 | - | - | - |
| F. Colif.** | counts/100mL | 10 | 100 | 400 | 5000 (20000)[a] | 5000 (20000)[a] | |
| Tot. Colif. | counts/100mL | 100 | 5000 | 5000 | 50000 | 50000 | >50000 |

N = No visible floatable materials/debris,
or No objectionable odour,
or No objectionable taste.

* = Related parameters, only one recommended for use

** = Geometric mean

a = Maximum not to be exceeded

CONTINUED ..... TABLE : 4

| PARAMETERS | (units) | CLASSES | | | | |
|---|---|---|---|---|---|---|
| | | I | IIA/IIB | III# | IV | V |
| CCE | µg/L | ↑ | 500 | - | - | - |
| MBAS/BAS | µg/L | N | 500 | 5000 (200) | - | - |
| O&G (mineral) | µg/L | A | 40;N | N | - | - |
| O&G(emulsified edible) | µg/L | T | 7000;N | N | - | - |
| PCB | µg/L | L | 0.1 | 6 (0.05) | - | - |
| Phenol | µg/L | E | 10 | - | - | - |
| | | V | | | | |
| Aldrin/ Dieldrin | µg/L | E L | 0.02 | 0.2 (0.01) | - | - |
| BHC | µg/L | S | 2 | 9 (0.1) | - | - |
| Chlordane | µg/L | | 0.08 | 2 (0.02) | - | - |
| t-DDT | µg/L | O | 0.1 | 1 (0.01) | - | - |
| Endosulfan | µg/L | R | 10 | - | - | - |
| Heptachlor/ Epoxide | µg/L | A | 0.05 | 0.9 (0.06) | - | - |
| Lindane | µg/L | B | 2 | 3 (0.4) | - | - |
| | | S | | | | |
| 2,4-D | µg/L | E | 70 | 450 | - | - |
| 2,4,5-T | µg/L | N | 10 | 160 | - | - |
| 2,4,5-TP | µg/L | T | 4 | 850 | - | - |
| Paraquat | µg/L | ↓ | 10 | 1800 | - | - |

N = Free from visible film, sheen, discoloration and deposits
\# = Maximum (unbracketed) and 24-hr average (bracketed) concentration

## IV.2 WATER QUALITY CLASSIFICATION

The system of use classification proposed is defined as follows:

| CLASS | USES |
|---|---|
| I | Conservation of natural environment<br>Water supply I --practically no treatment necessary (except by disinfection or boiling only)<br>Fishery I - very sensitive aquatic species |
| IIA | Water supply II - conventional treatment required<br>Fishery II - sensitive aquatic species |
| IIB | Recreational use with body contact |
| III | Water supply III - extensive treatment required<br>Fishery III - common, of economic value, and tolerant species<br>Livestock drinking |
| IV | Irrigation |
| V | None of the above |

CONTINUED ..... TABLE : 4

| PARAMETERS | (units) | CLASSES I | IIA/IIB | III# | III# (bracketed) | IV | V |
|---|---|---|---|---|---|---|---|
| Al | mg/L | NATURAL LEVELS (all parameters) | – | – | (0.06) | 0.5 | LEVELS ABOVE IV (all parameters) |
| As | mg/L | | 0.05 | 0.4 | (0.05) | 0.1 | |
| Ba | mg/L | | 1 | – | | – | |
| Cd | mg/L | | 0.01 | 0.01* | (0.001) | 0.01 | |
| Cr(VI) | mg/L | | 0.05 | 1.4 | (0.05) | 0.1 | |
| Cr(III) | mg/L | | – | 2.5 | | – | |
| Cu | mg/L | | 1 | – | | 0.2 | |
| Hardness | mg/L | | 250 | – | | – | |
| Ca | mg/L | | – | – | | – | |
| Mg | mg/L | | – | – | | – | |
| Na | mg/L | | – | – | | 3 SAR | |
| K | mg/L | | – | – | | – | |
| Fe | mg/L | | 0.3 | 1 | | 1 (leaf) 5 (others) | |
| Pb | mg/L | | 0.05 | 0.02* | (0.01) | 5 | |
| Mn | mg/L | | 0.1 | 0.1 | | 0.2 | |
| Hg | mg/L | | 0.001 | 0.004 | (0.0001) | 0.002 | |
| Ni | mg/L | | 0.05 | 0.9* | | 0.2 | |
| Se | mg/L | | 0.01 | 0.25 | (0.04) | 0.02 | |
| Ag | mg/L | | 0.05 | 0.0002 | | – | |
| Sn | mg/L | | – | 0.004 | | – | |
| U | mg/L | | – | – | | – | |
| Zn | mg/L | | 5 | 0.4* | | 2 | |
| B | mg/L | | 1 | – | (3.4) | 0.8 | |
| Cl | mg/L | | 200 | – | | 80 | |
| $Cl_2$ | mg/L | | – | – | (0.02) | – | |
| CN | mg/L | | 0.02 | 0.06 | (0.02) | – | |
| F | mg/L | | 1.5 | 10 | | 1 | |
| $NO_2$ | mg/L | | 0.4 | 0.4 | (0.03) | – | |
| $NO_3$ | mg/L | | 7 | – | | 5 | |
| P | mg/L | | 0.2 | 0.1 | | – | |
| Si | mg/L | | ~50 | – | | – | |
| $SO_4$ | mg/L | | 250 | – | | – | |
| S | mg/L | | 0.05 | – | (0.001) | – | |
| $CO_2$ | mg/L | | – | – | | – | |
| Gross-α | Bq/L | | 0.1 | – | | – | |
| Gross-β | Bq/L | | 1 | – | | – | |
| Ra-226 | Bq/L | | <0.1 | – | | – | |
| Sr-90 | Bq/L | | <1 | – | | – | |

* = At hardness 50 mg/L $CaCO_3$

# = Maximum (unbracketed) and 24-hr average (bracketed) concentrations

1. Purpose

1.1 The purpose of this paper is to present an overview of the environmental problems faced by the Klang River, a major urban river of this country.

1.2 The participants of this workshop thus will be exposed to the basic knowledge of water quality management and water pollution. It is not the intention of the writer to impart highly technical or academic mumbo jumbo.

1.3 A major part of the information presented in this paper is drawn from the recent Klang Valley Environmental Improvement study conducted by Engineering Science Incorporated of the United States and SEATEC International in conjunction with the Department of Environment, Malaysia.

2 Klang River System

2.1 The Klang River drains an area of about 1200 sq. Km extending from the headwaters in the steep mountain forests of the Main Range of Peninsular Malaysia to the river mouth for a total length of 120 Km. The main tributaries of Sungai Klang are Sungai Batu, Sungai Gombak, Sungai Ampang, Sungai Kerayong, Sungai Damansara, Sungai Keroh, Sungai Jinjang, Sungai Penchala and Sungai Kuyoh. The river system drains all the major urban centers in Klang Valley, viz. Kuala

Lumpur, Petaling Jaya, Subang Jaya, Shah Alam, Klang and Port Klang (Figure 1 and 2).

2.2 The effective watershed basins of the Sungai Klang, Sungai Batu and Sungai Gombak are relatively small. As a result of the mountainous nature of these upper reaches and rapid development ongoing within these catchment areas, extreme high flows are experienced during the rainy season and periods of sudden thunderstorms. Construction of the Klang Gates Dam has significantly reduced natural flow in Sungai Klang.

2.3 The Batu Dam will be fully operational by 1988 and this will further reduce the natural flow of Sungai Batu and Sungai Klang (downstream of Sungai Gombak_Sungai Klang confluence near the Jamek Mosque).

## 3. Pollution Sources

### 3.1 Community (Domestic) Wastewater

There are four different wastewater disposal systems used within the Klang River Basin, namely municipal sewerage, individual community sewerage, building systems and non-sewered system.

The populations in Kuala Lumpur serviced by existing facilities as of 1984 are listed below :

| Facilities | Population (thousand) |
|---|---|
| <u>Sewerage</u> | |
| Septic tank | 336 |
| Imhoff tank | 157 |
| Treatment (city sewerage and individual community sewerage) | 425 |
| <u>Non-sewered system</u> | |
| Bucket nightsoil | 30 |
| Four-flush latrine | 105 |
| Pit privies | 106 |
| Latrines over watersource (hanging latrines) | 12 |
| Others | 12 |
| Total | 1213 |

Individual building systems in the Klang River Basin are generally served by septic tank without any accompanying soakaway or leaching pit. Almost without exception, septic tank effluent is discharged direct to the surface water drain, along with sullage which invariably by-passes the septic tank. The degree of treatment afforded by most septic tanks is negligible because most of them are never desludged. Individual community systems are normally built by the developer of a particular community/housing area and usually comprise Imhoff tanks with effluent filters, oxidation ponds or aerated lagoons. The maintenance of Imhoff tanks and filters is usually neglected and the resulting treatment efficiency of the system is quite low (about 10%).

## 3.2 Industrial wastewater

The distribution of the major industrial and agro-industrial sources of water pollution in the Klang River Basin are shown in Figure 1 . However the Department of Environment (DOE) records are incomplete for smaller industries and the usually illegal "backyard" industries. The wastewater data compiled by the DOE are based on information submitted by the industries and represent the effluent flow and load characteristics after in-plant treatment, if any.

## 3.3 Solid wastes

A significant portion of the total solid wastes not collected within the Klang River basin, not burned nor buried, finds its way into the waterways. It is estimated that the total non-collected refuse in Klang Valley amounted to some 403 tons/day and of this it is is estimated that some 120 tons/day are buried, 200 tons/day burned and 65 tons/day reach the rivers.

### 3.4 Farm waste and agricultural runoff

Major agricultural activities in the region include rubber, oil palm and coconut cultivation. Animal husbandry activities include pig and poultry farming. Plantation activities are fairly well managed and agricultural chemicals (fertilizer, chemicals, etc) are well controlled but the surface runoff from these plantations could increase nitrate and phosphate nutrient levels and possibly increase levels of eutrophication.

Pig farms are concentrated near new village settlements like Subang. Most large farms (over 3000 pigs) use single stage anaerobic ponds which provide varying degrees of treatment but many do not perform satisfactorily due to design deficiencies and to poor operation and maintenance. There are many smaller farms without any treatment whatsoever which discharge waste direct into waterways.

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4.5 "In-situ" reading are also carried out namely for dissolved oxygen (DO), turbidity, pH, salinity, conductivity and temperature using specific electronic meters.

4.6 Data obtained ("in-situ" reading and results of chemical analyses) are stored in a computer but beforehand results are scanned for discrepancies such as sudden changes in certain parameters. These discrepancies are for the Enforcement Unit to act on by checking the possible polluting sources upstream of the monitoring station.

## 5. Water Quality

### 5.1 BOD and DO

As shown in Figure 4, for 1981-1984 conditions, the river water BOD increased markedly when the river flowed through the urban areas, and correspondingly the DO decreased. By the time the river met the sea, the DO level was very low from time to time, as low as or less than 1 mg/l. This means that the river was sometimes barely aerobic during the critical low flow period. The widening gap between BOD loading and river DO capacity will sooner or later cause the river to become septic over appreciable time periods over its lower reaches, unless suitable corrective measures are undertaken. This transition to gross septic conditions is expected to take place within the next 5 to 10 years.

5.2 Other parameters

The patterns of change along the river for other pollutant parameters are shown in Figures 5 to 11. These patterns are similar to that of BOD which is, low near the river source but increasing as it passes through industrial and built-up urban areas.

5.3 Water Quality Index (WQI)

The Department of Environment uses the weighted average of several major parameters namely BOD, COD, suspended solids, pH and ammoniacal nitrogen to calculate Water Quality Indices of Malaysian rivers. Therefore, the trend of water quality from year to year can be observed. Anyway, there are scepticism as of the acceptibility of such calculation relative to other statistical methods.

According to the WQI trends, the Klang River water quality is in a yo-yo pattern although there are some improvements.

## 6. Epilogue

6.1 The Water quality of most Malaysian rivers has changed for the better over the past 10 years as a result of water pollution control actions brought about by appropriate legislative and institutional arrangements but sad to say, the statement is not generally true for the river that runs through the Malaysian capital. Actually, the quality of the Klang River might take a turn for the worse unless suitable corrective measures are undertaken.

6.2 Domestic wastewater should receive the same attention as organic industrial effluents and be required to meet the appropriate effluent quality requirements by centralised treatment facilities. This is especially true for the Klang River basin which carries the heavy burden of rapid industrialization, urbanization and population growth.

6.3 There is also a need for a reappraisal of the level of competency of many local authorities in implementing and enforcing various laws and rules for soil conservation, control of run-offs from contruction sites, logging sites, tin mines, earthworks or other land development activities. This is because there is no general improvement of the suspended solids parameter in many Malaysian rivers and some rivers are getting worse (including Klang River). Nevertheless, a joint effort by all relevant agencies is greatly needed to overcome various aspects of problems related to environmental management.

## ACKNOWLEDGMENT AND DISCLAIMER

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APPENDIX 1

KLANG RIVER WATER MONITORING STATIONS FOR WQR 18

| STATION NUMBER | RIVER | DISTANCE (Km) FROM ESTUARY | REMARKS |
|---|---|---|---|
| 3013601 | KLANG | 2.25 | Bridge near the estuary |
| 3014602 | KLANG | 18.19 | Bridge at Klang Town |
| 3117605 | KLANG | 90.80 | At Kg. Datok Keramat (near Multipurpose Hall) |
| 3014603 | KLANG | 23.18 | Kota Bridge, Klang |
| 3117629 | AMPANG | 90.80 | Near Ampang/Klang Confluence |
| 3015637 | DAMANSARA | 52.49 | Batu 3, Shah Alam |
| 3116620 | KEROH | 91.00 | Bridge near Datsun Service station, Segambut. |
| 3016624 | PENCHALA | 65.04 | 8th. mile, Jln. Klang Lama |
| 3216621 | JINJANG | 92.00 | Near Batu Elementry School, Jalan Bernam |
| 3016607 | KLANG | 74.06 | Bridge at Kg. Petaling Bahagia |
| 3217619 | GOMBAK | 96.28 | At the corner to Batu Caves |
| 3117610 | KLANG | 83.72 | Bridge at Jln. Dang Wangi |
| 3217627 | BATU | 97.08 | Bridge at Batu Caves |
| 3117626 | GOMBAK | 86.94 | Jln. Tun Razak Bridge near Jln. Ipoh |
| 3217603 | KLANG | 97.24 | Bridge near National Zoo |
| 3015622 | KLANG | 44.76 | Bridge near Seman Estate |
| 3015632 | DAMANSARA | 55.00 | 2 Km from Monfort Boys Home |
| 3016623 | KUYOH | 72.45 | 7.5 mile Jln. Puchong |

| STATION NUMBER | RIVER | DISTANCE (Km) FROM ESTUARY | REMARKS |
|---|---|---|---|
| 3117630 | KLANG | 84.36 | Brickfields, junction to Jln. Lornie |
| 3116604 | BATU | 90.16 | Bridge near Maxwell School |
| 3016631 | KLANG | 62.79 | Puchong Weir |
| 3016625 | KERAYONG | 79.53 | 14th. mile Jln. Klang Lama |

APPENDIX 2

LIST OF PARAMETERS MEASURED FOR KLANG RIVER

| | |
|---|---|
| Dissolved Oxygen (mg/l) | Oil and Grease (mg/l) |
| Temperature ( C) | Phenol (mg/l) |
| Color (Hazen) | Detergents (MBAS) (mg/l) |
| Turbidity (FTU) | PCB (mg/l) |
| Conductivity ( /us) | Organochlorine (mg/l) |
| Salinity (o/oo) | Organophosphate (mg/l) |
| pH .o | Carbamate (mg/l) |
| BOD5 at 20 C | Fre. Coliform (MPN/100 ml.) |
| COD | E. Coli (MPN/100 ml.) |
| Ammoniacal-Nitrogen | As (mg/l) |
| Nitrate-Nitrogen | B (mg/l) |
| Total Nitrogen | Cd (mg/l) |
| Chloride (mg/l) | Cr (mg/l) |
| Fluoride (mg/l) | Cu (mg/l) |
| Cyanide (mg/l) | Fe (mg/l) |
| Sulphide (mg/l) | Pb (mg/l) |
| Sulphate (mg/l) | Mn (mg/l) |
| Phosphate (mg/l) | Ca (mg/l) |
| Hardness (mg/l) | Mg (mg/l) |
| Suspended Solids (mg/l) | Ni (mg/l) |
| Dissolved Solids (mg/l) | Zn (mg/l) |
| Total Solids (mg/l) | Hg (mg/l) |